

We claim as our invention:

1. A culturing device comprising:
at least one culture container adapted to receive and to discharge a culture medium;
a cell culture insert removably received within the at least one culture container;
at least one supply mechanism for introducing the culture medium into the at least one culture container and for discharging the culture medium from the at least one culture container; and
at least one level sensor cooperating with the at least one culture container to sense a level of the culture medium for the at least one culture container, wherein the sensor controls the supply mechanism as a function of an output signal of the level sensor representing the level of the culture medium such that a submerged culture medium supply condition and a basal culture medium supply condition can both be achieved by the device.

2. A culturing device as defined in claim 1, wherein the cell culture insert each provides a horizontal culture surface within the at least one culture container.

3. A culturing device as defined in claim 1, further comprising at least one pair of discharge lines in fluid communication with the individual culture containers.

4. A culturing device as defined in claim 3, wherein the at least one culture container comprises a plurality of culture containers, and wherein each pair of the discharge lines is associated with a respective one of the culture containers.

5. A culturing device as defined in claim 3, wherein the at least one culture container comprises a plurality of culture containers, and wherein at least one pair of the discharge lines is associated with more than one of the individual culture containers.

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6. A culturing device as defined in claim 1, wherein the at least one culture container is positioned so that a culture surface defined by the corresponding cell culture insert lies in a common horizontal plane.

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7. A culturing device as defined in claim 1, wherein the at least one culture container comprises a plurality of culture containers, and wherein each of the plurality of culture containers is connected to a common culture medium supply line.

8. A culturing device as defined in claim 7, wherein a culture medium supply line is connected to the at least one culture container and communicates with a riser on which the at least one level sensor is carried.

9. A culturing device as defined in claim 8, wherein the at least one level sensor is vertically adjustable relative to the riser.

10. A culturing device as defined in claim 1, wherein the at least one level sensor comprises a plurality of level sensors, and wherein at least one of the plurality of level sensors includes a forked photoelectric barrier.

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11. A culturing device as defined in claim 1, wherein at least one of the level sensors continuously measures the culture medium level.

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12. A culturing device as defined in claim 1, wherein the at least one level sensor comprises a plurality of level sensors, and wherein at least one of the plurality of level sensors includes a level switch that responds to a predetermined target level.

13. A culturing device as defined in claim 1, further comprising:
an exterior housing;
a plurality of discrete modules within the housing wherein at least one of the at least one culture container is arranged within each of the modules; and
a culture medium supply distribution system in fluid communication with a common culture medium supply line and with each of the modules.

14. A culturing device as defined in claim 13, wherein the supply distribution system has a single connection in fluid communication with the at least one supply mechanism, and wherein the single connection is disposed at a lowermost elevation of the supply distribution system.

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15. A culturing device as defined in claim 13, wherein the exterior housing has a plurality of separate connectors each coupled to a withdrawal line of a respective one of the discrete modules.

16. A culturing device as defined in claim 13, wherein each of the discrete modules includes a discrete temperature-control housing surrounding the at least one of the at least one culture container within the corresponding discrete module, and wherein each temperature-control housing has a temperature-control medium inlet and a temperature-control medium discharge.

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17. A culturing device as defined in claim 16, wherein each temperature-control medium discharge is in fluid communication with an overflow apparatus lying in an upper region of the respective temperature-control housing, and wherein the overflow apparatus is positioned diametrically opposite to the temperature-control medium inlet within the respective temperature-control housing.

18. A culturing device as defined in claim 17, wherein the temperature control medium inlet and discharge of the temperature-control housing of each of the discrete modules is connected in series relative to a flow path of the temperature-control medium.

19. A culturing device as defined in claim 1, wherein the at least one culture container is disposed within an exterior housing that can provide a sealed environment within an interior of the housing.

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20. A culturing device as defined in claim 19, wherein the outer housing has at least one connection for introducing a gaseous medium into the interior of the housing.

21. A culturing device as defined in claim 1, wherein certain components of the culturing device that must be sterilized are fabricated from materials that can withstand sterilization.

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22. A culturing device as defined in claim 21, wherein the sterilizable materials are selected from a group comprising at least one of glass and silicone.

23. A culturing device as defined in claim 1, wherein the supply mechanism includes a bidirectional pump.

24. A culturing device as defined in claim 23, wherein the bidirectional pump is a peristaltic pump.

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25. A culturing device as defined in claim 1, wherein the at least one level sensor comprises a pair of level sensors wherein one of the sensors controls the supply mechanism for the submerged supply condition and the other of the sensors controls the supply mechanism for the basal supply condition.

26. A culturing device as defined in claim 1, further comprising:
a programmable controller that can control a culture medium target level transducer in a time-dependent manner.

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27. A culturing device as defined in claim 26, wherein the programmable controller can adjust a target level value periodically between at least two level values, a first level value corresponding to a liquid level that is a predetermined distance above a top side of a culture surface of the cell culture insert in the at least one culture container, and a second level value corresponding to a liquid level that is a predetermined distance below the first level.

28. A method for culturing a culture material such as cells and tissue components, the method comprising the steps of:
providing a culturing device having at least one culture container and at least one nutrient solution supply mechanism;

placing a cell culture insert within the at least one culture container to expose the culture material carried on a culture surface; and

supplying a nutrient solution for the culture material to the at least one culture container such that a liquid level of the nutrient solution can be adjusted between at least a submerged culturing level of the nutrient solution and a basal culturing level of the nutrient solution.

29. A method as defined in claim 28, further comprising the step of: exposing the culture material to at least one other substance during periods where the liquid level is at the basal culturing level, and wherein the at least one other substance is selected from at least one of a solid, gaseous or aerosol-form substance.

30. A method as defined in claim 28, wherein the step of providing the supply mechanism further includes providing a sensor for sensing the liquid level and a pump controlled by the sensor for supplying the nutrient solution.

31. A method as defined in claim 28, wherein the step of supplying is carried out with the aid of a programmable controller to automatically adjust the liquid level over a time period.

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